Remarks at the

Corporation Dinner
of the
Polytechnic Institute of Brooklyn

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A few days ago at lunch one of my friends inquired, "What are you going to talk about at the Corporation Dinner on Tuesday?" I replied with the old wheeze, "About twenty minutes, as requested." "Well," he said, "if you wish to make the headlines, you ought to talk on the subject 'The Strategic Merits of the B-36'." Having no desire for the headlines, I will instead speak about some of the recent trends in aeronautical engineering.

But before beginning that subject, I wish to express my great appreciation to the Polytechnic Institute of Brooklyn for the high honor to be conferred upon me tomorrow and for the accompanying privilege of being one of the guests tonight. I have had the pleasure of attending the Corporation Dinner on three previous occasions when aeronautical engineers were guests of honor, and I understand the special nature of the distinction thus conferred. The outstanding eminence of the past recipients causes me to wonder somewhat why my name is to be added to the list. The scientific work associated with my name was, as is so often the case, the product of a research team, a group at the National Bureau of Standards whose work was and still is sponsored by the National Advisory Committee for Aeronautics. At present I am an administrator, desk sitter, conference attender, and occasionally scientist trying to facilitate the work of

that large group of research scientists, engineers, and supporting co-workers, who together constitute the NACA staff. I am tonight a representative, or more accurately, a symbol of these larger groups.

And now to my subject. I remember a meeting of the Institute of the Aeronautical Sciences in New York some years ago when Frank Caldwell characterized the state of aeronautical engineering as being like that of a hula-hula dancer whose grass skirt was on fire. Those were the days when the airplane was beginning to be complicated by controllable pitch propellers and retractable landing gears; the days when the composition began to be beyond the capacity of the soloist and to require the harmonious effort of an orchestra of specialists. I do not know what image Frank would conjure up in your minds to picture the state of the art today. Certainly it is changing rapidly and making greater demands upon the skill and power of coordination of those who presume to guide its destiny than ever before. To this aspect we will return later.

The present period of aeronautical development has been described as one of technical revolution, and the exhibits cited in evidence are the several new power plants--turbo-jet, rocket, and ram jet, the new look of sweptback wing configurations, and the dawn of the supersonic age with Captain Yeager's flight at supersonic speed in October 1947. In point of fact the moving pace of airplane speed records with the passing years shows a sharp and almost discontinuous upturn from a rate of increase of about fourteen miles per hour per year over the past forty years to a much higher rate and this high rate

will probably continue for several years. This revolution is not as yet in evidence in our transport aircraft, but history shows a lag of about fifteen to twenty years between transport aircraft and those making speed records. Not until 1960 or 1965 would past experience predict transport speeds to show the sharp upturn. Yet, as most of you know, transports specifically designed for jets will fly experimentally in Canada and Great Britain this year or next. I think that it is easy to see that speeds and altitudes of air transport will move much higher but it is hard to predict accurately the date of reaching any specified level. At present, the skeptic is blinded by the inefficiencies of present conventional aircraft configurations, the present high fuel consumption of jet engines, and many other technical disabilities which the ingenuity of research and development scientists and engineers will ultimately ameliorate. The skeptic is correct in feeling that our present transports will play an essential role for many years to come and that to some degree the transports of the future will create and fulfill new transport needs.

Some of the differences of opinion in assessing the present state of aeronautical development and its trends arise from the selective vision of the observer. There are at any instant aircraft in all possible states of development and the problem of surveying their status is like that of surveying the status of the human race. I, with research interest, look at the youngsters about to be born or at least very young. The operator of military or transport aircraft looks at the mature individuals of established reputation and in

position to assume responsibility. The skeptic sees the inexperience of the youth and his faults not yet corrected. All of us are to a degree correct in our assessments and I can assure you that if I were an airline operator, I would not today purchase research aircraft. However, I think I would be much interested in the research as the harbinger of the future.

The aeronautical engineer is already becoming aware of the increasing tendency of his problems to interact one with the other. In the past, for example, the aerodynamics and the structures groups could work more or less independently, the aerodynamicist designing the external shape and the structural engineer the internal configuration. As speeds were increased, a new type of difficulty, flutter, arose as a consequence of the simultaneous effects of structural deflections and air loads. At present speeds, it is hard to untangle the structures problem from the aerodynamic problem, the two being intermingled in an aeroelastic problem. Control power, stability, and in fact, all flying qualities depend on an interplay between the deflections of the structure due to air loads and the air loads due to the deflections of the structure. Thus deflecting the aileron to increase the wing lift twists the wing and the twisting of the wing reduces the wing lift. The resultant effect may be to actually reduce the wing lift.

In similar fashion it is becoming difficult to separate the propulsive force from the resistance to motion. Power plant and airframe interact one on the other. An unusual degree of integration and technical compromise is

required, extending to every device used on the aircraft. The old types of radar and radar antennas cost too much in resistance to motion. Flush antennas and tail surfaces used as antennas as well as tail surfaces, require design by engineers versed in electronics, aerodynamics, and structural design. The design of autopilots and the adaptation of their characteristics and the aerodynamic characteristics of the airplane to each other to give optimum results demands an integration of design based on several disciplines which has hitherto not been required. Design groups working on guided missiles have had to learn by trial and failure the necessity of integrated design and techniques of assembly teams to accomplish such designs. It is not necessary for me to dwell on the changes in the education of aeronautical engineers which are demanded by such developments.

The trend to higher speeds and altitudes of flight has emphasized the need of supplementing the human senses and has led to increasing mechanization and automaticity. The problem has become most acute in the case of military aircraft and some observers have wondered why the human being is placed in the aircraft at all. The principal reason is, of course, the element of human judgment not easily duplicated by an inanimate mechanism. Moreover, it is believed that high-speed aircraft will be wanted because human beings wish to travel fast and far. Few people decline to ride on automatically controlled high-speed elevators merely because the control is automatic. Radar to extend human vision, new navigation devices, new types of communication

equipment, autopilots controlled by signals from navigation and landing beams, all are in various stages of development. There are some aeronautical people who may desire a return to the simpler methods of yesterday. I do not believe these desires will be fulfilled in this field any more than in other technical fields.

Such are the visible portents of the approaching future for aircraft and for the problems of the engineers who design them. The problems of the society who sponsor, own, and use these devices are no less complex. The increasing contacts between the various social systems of the nations of the world promote knowledge of other customs, other hopes, and other ideals. Sometimes the knowledge leads to better understanding; sometimes unfortunately to the sharpening of tensions. Today our nation finds the airplane the principal instrument of national security, yet hoping to utilize and transform this instrument from sword to plowshare. Tomorrow, may it become without question the promotor of commerce and trade and the carrier of friendliness and good will.

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